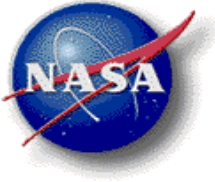


# **Corrosion Mitigation and Control at NASA Kennedy Space Center**

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**Innovative Partnerships Development**  
**NASA Kennedy Space Center**

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# Introduction

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**The environment at KSC is extremely corrosive:**

- **Ocean salt spray**
- **Heat**
- **Humidity**
- **Sunlight**

**Launch Complex 39A & 39B**

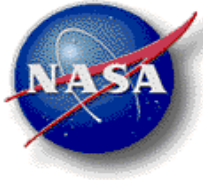


**In 1981 the Space Shuttle  
introduced acidic deposition  
conditions**

**SRB Exhaust**





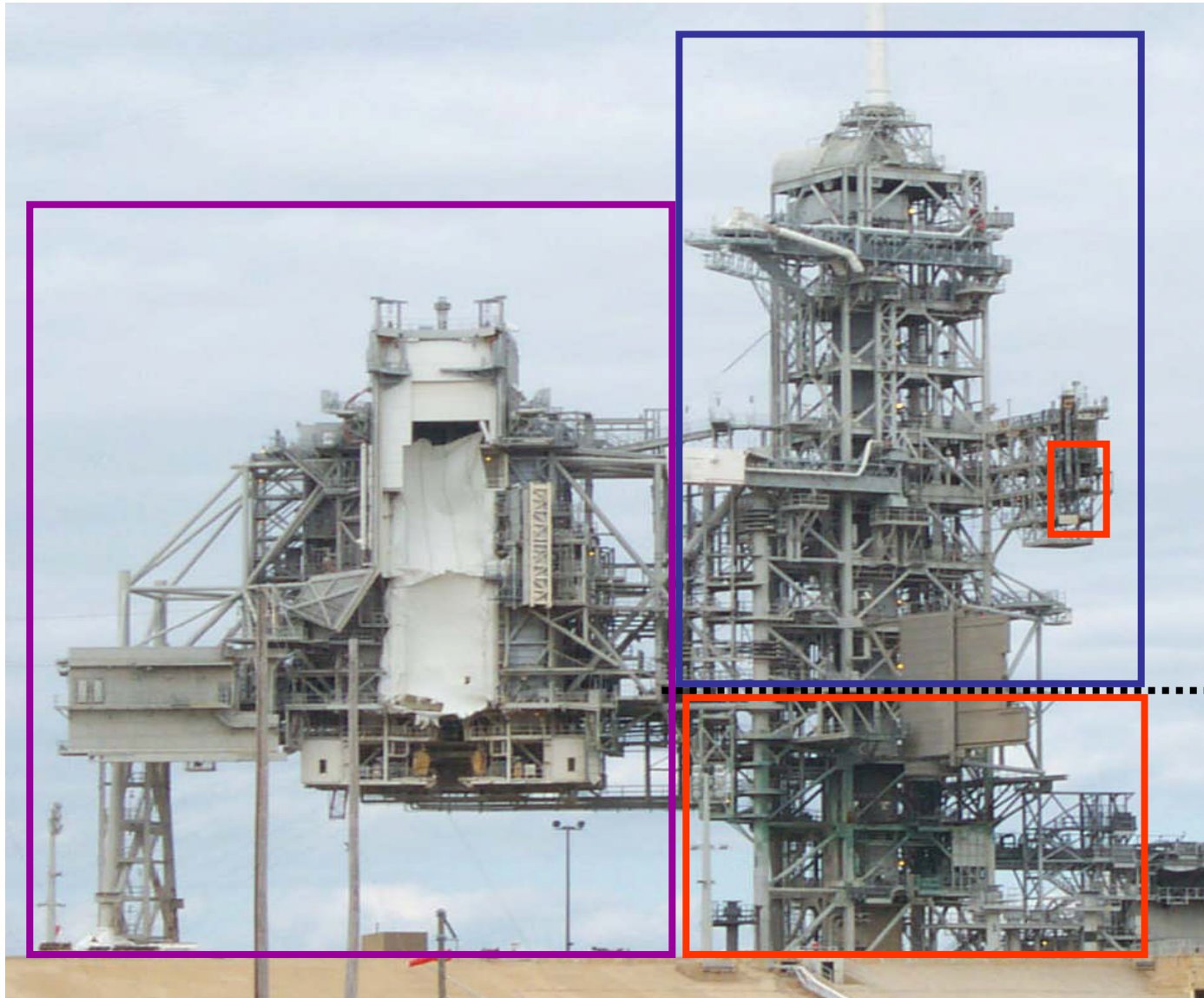


# Launch Complex After Launch

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# Launch Complex 39 Zones of Exposure

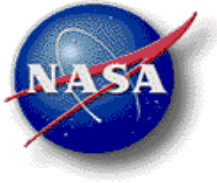


**Zone 3:** Surfaces, other than those located in Zones 1 or 2, that receive acid deposition from solid rocket booster exhaust products

**Zone 2:** Surfaces that receive elevated temperatures and acid deposition from solid rocket booster exhaust with no exhaust impingement.

**FSS 115" Level**

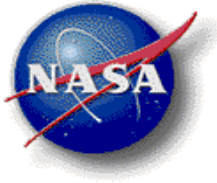
**Zone 1:** Surfaces that receive direct rocket engine exhaust impingement.



# NASA's Protective Coatings Standard

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- **NASA STD-5008: Protective Coating of Carbon Steel, Stainless Steel, and Aluminum on Launch Structures, Facilities, and Ground Support Equipment (GSE)**
    - Establishes practices, methods, and procedures for the protective coating of launch structures, GSE, and related NASA facilities worldwide.
    - Contains the Qualified Products List.
-



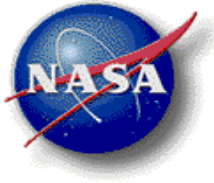
# NASA's Protective Coatings Standard

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- **Purpose**

- **To establish uniform engineering practices across NASA programs**
  - **To provide a design standard for the development of specifications and requirements for**
    - **Safety**
    - **Materials**
    - **Equipment**
    - **Procedures**
    - **Quality assurance inspections**
    - **Provide and maintain a qualified products list**
-





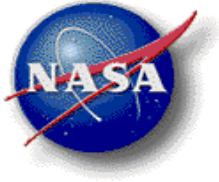
# NASA STD-5008 QPL Qualification Process

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- **Atmospheric testing at the Corrosion Technology Atmospheric Test Facility**







# Corrosion Mitigation and Control

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- **Coating Development**
    - **Development of cutting edge corrosion mitigation and control technologies that are environmentally friendly**
-

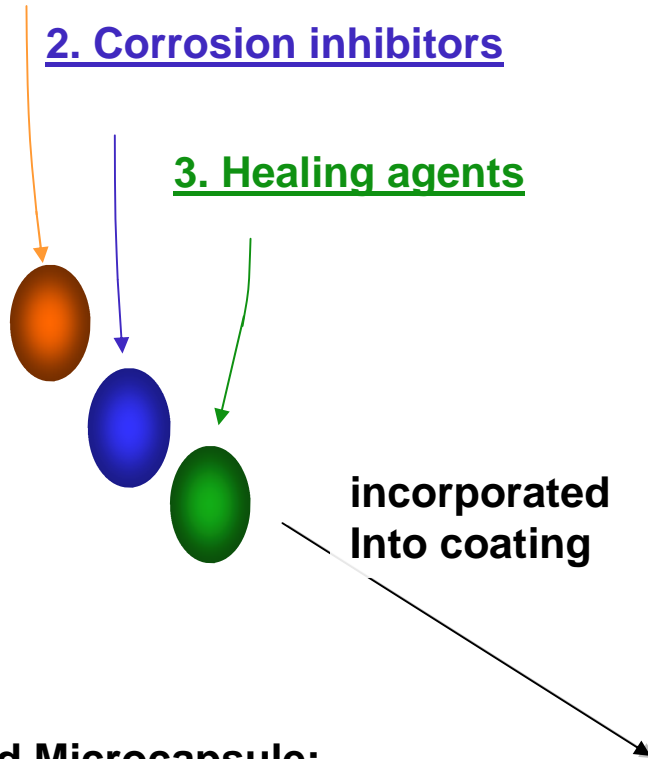


# Smart Coating Development Concept

## 1. Corrosion indicators

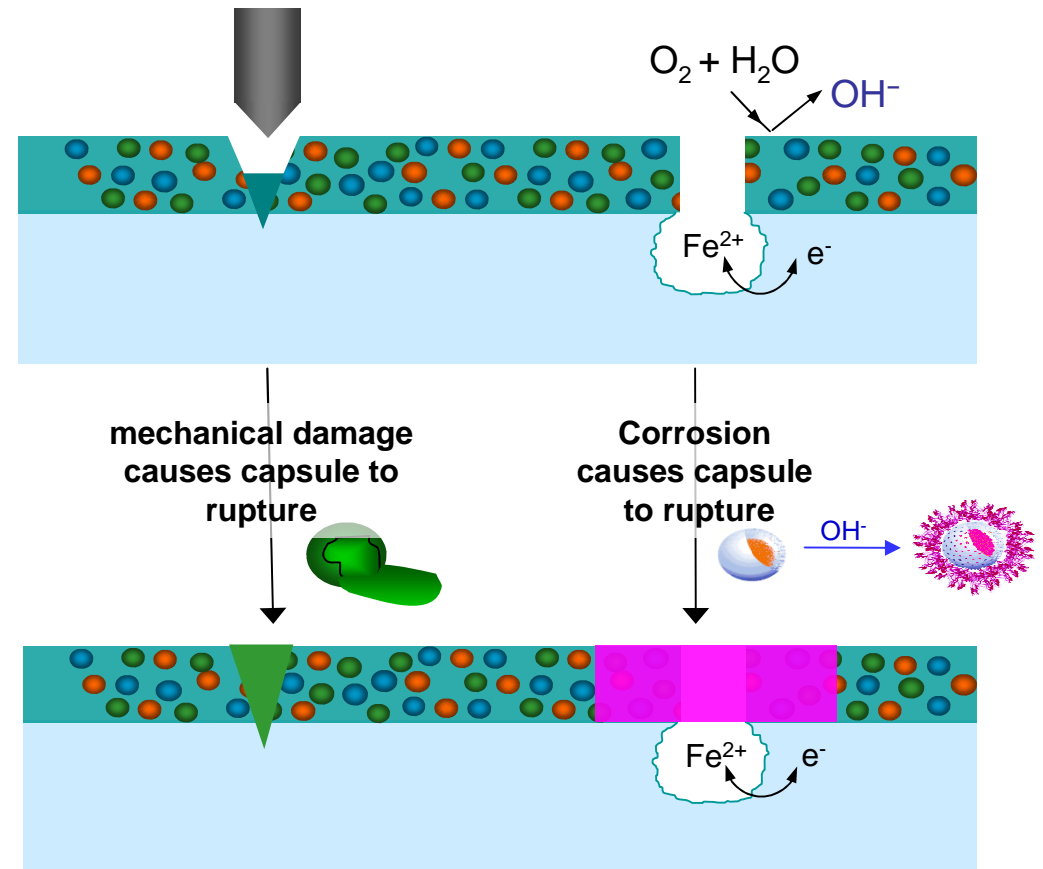
## 2. Corrosion inhibitors

## 3. Healing agents

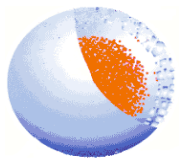


### Ruptured Microcapsule:

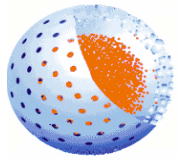
- indicates corrosion
- protects metal from corrosion
- repairs damaged area



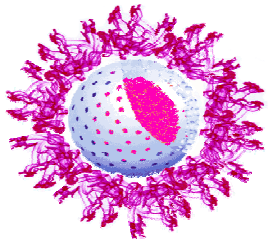
# pH Sensitive Microcapsules



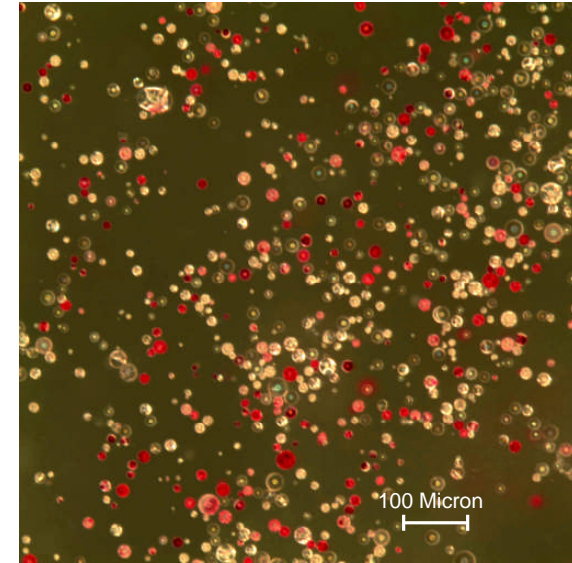
Microcapsule containing pH indicator  
(inhibitor, self healing agents)



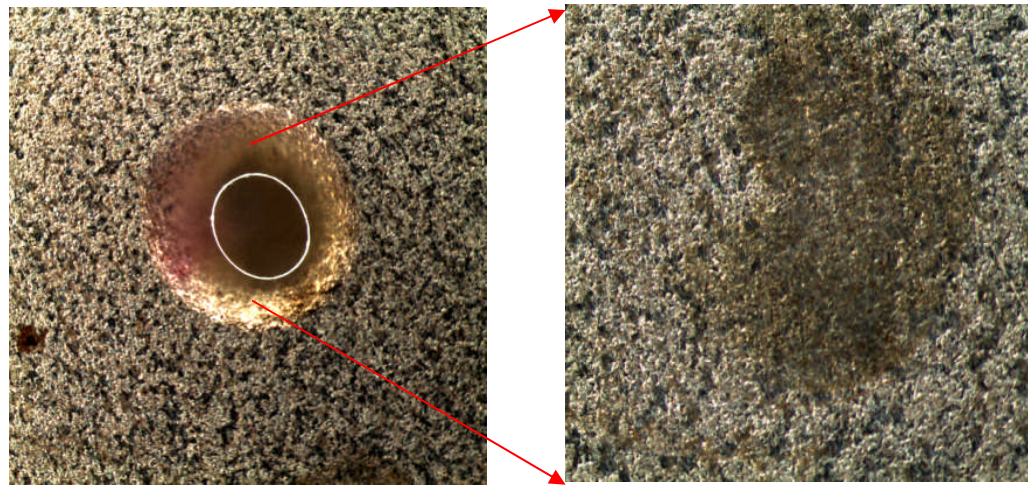
The shell of the microcapsule breaks down  
under basic pH conditions through the ester  
hydrolysis reaction



pH indicator changes color and is released  
from the microcapsule under basic conditions

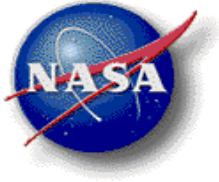


Color change due to Microcapsules in  
solution responding to basic pH conditions



Microcapsules in solution indicating presence of localized corrosion on carbon steel substrate

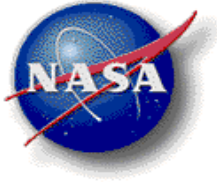




# Conclusions

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- **Corrosion Control and Mitigation for NASA Kennedy Space Center**
  - NASA STD-5008 procedures
  - Atmospheric Coating Testing
  - Coating Development
- **Taking advantage of new and improved technologies could dramatically reduce expensive corrosion related repairs and possible catastrophic failures.**



## Contact Information

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